

Đề kiểm tra lập trình nhập môn phân tích dữ liệu và học sâu

Sinh viên không được phép sử dụng internet

Sinh viên sau khi làm bài xong xuất ra file PDF đồng thời nộp lên Fit-lab và push lên git-hub

Sinh viên làm bắt đầu làm bài từ 15h40 - 18h00

```
# Họ và Tên: Đào Duy Luân
# MSSV: 2174802010599

from torchvision import datasets
from torch.utils.data import Dataset, DataLoader
import torch
import torch.nn as nn
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import Dataset, DataLoader, random_split
import numpy as np
from sklearn.datasets import load_iris
import matplotlib.pyplot as plt
import pandas as pd
from torch.utils.data import Dataset, DataLoader
import torch
import torch.nn as nn
import torch.optim as optim
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from torch.optim import SGD
from torch.utils.data import DataLoader, TensorDataset

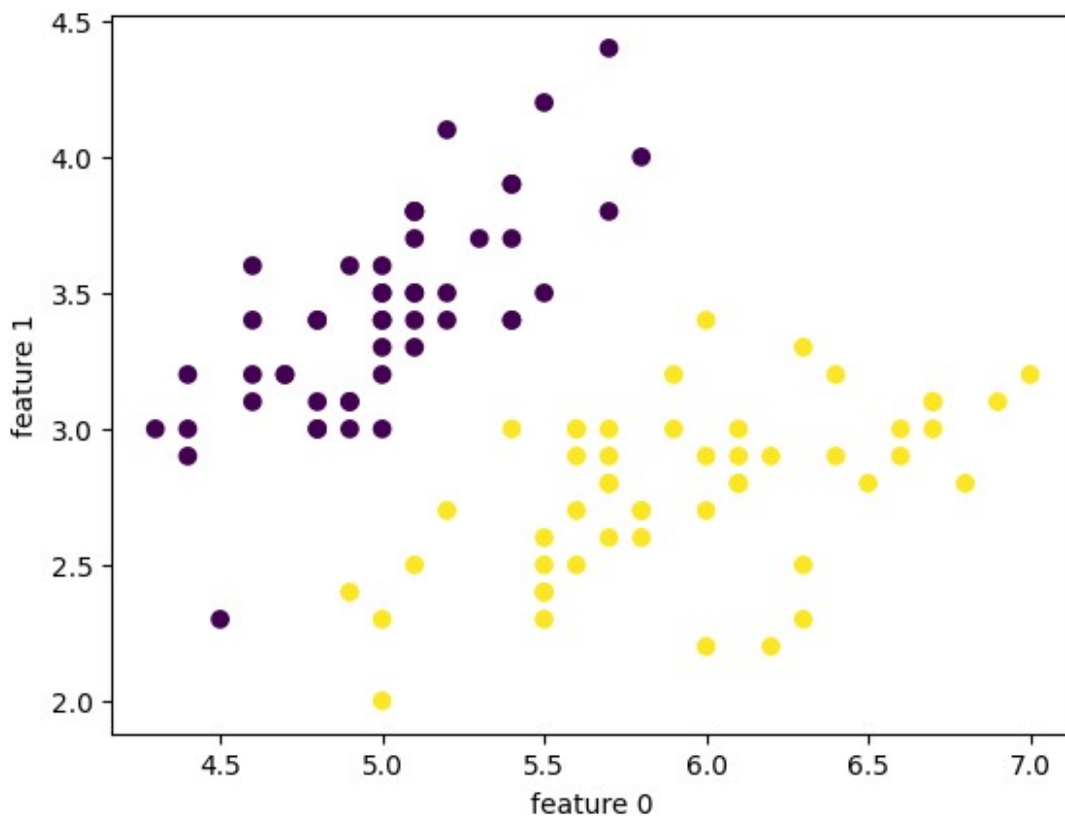
#Bước 1: Load data
def load_dataset():
    X, y = load_iris(return_X_y=True)
    X = X[y!=2]
    y = y[y!=2]
    return X,y
#Điền ở đây
X,y = load_dataset()
print((X.shape,y.shape))

((100, 4), (100,))
```

Kết quả: (100, 4) (100,)

```
#Trực quan hóa dữ liệu data
#Điền code ở đây
#Trực quan hóa dữ liệu data
#Điền code ở đây
def load_dataset():
    X, y = load_iris(return_X_y=True)
    X = X[y!=2]
    y = y[y!=2]
    return X,y
#Điền ở đây
X,y = load_dataset()
print( X.shape,y.shape )
plt.scatter(X[:,0], X[:, 1], c=y)
plt.xlabel('feature 0')
plt.ylabel('feature 1')
plt.show()

(100, 4) (100,)
```



Kết quả

image.png

```
# Bước 2: Định nghĩa mô hình hồi quy logistic bằng PyTorch
class LogisticRegressTorch(nn.Module):
    def __init__(self, n_features):
        super(LogisticRegressTorch, self).__init__()
        #Điền ở đây theo comment # tạo một lớp tuyến
        tính (nn.Linear) với n_features đầu vào và 1 đầu ra
        self.linear = nn.Linear(n_features, 1)
    def forward(self, x):
        return torch.sigmoid(self.linear(x))

# Bước 3: Định nghĩa lớp dữ liệu
class IrisTorch(Dataset):
    def __init__(self, X, y):
        self.X = torch.tensor(X, dtype=torch.float32)
        self.y = torch.tensor(y, dtype=torch.float32).unsqueeze(1)

    def __len__(self):
        return len(self.X) #Điền ở đây theo comment #tra'
        về số lượng mẫu trong tập dữ liệu (số lượng hàng trong self.X)

    def __getitem__(self, idx):
        return self.X[idx], self.y[idx] #Điền ở đây theo comment
        #tra' về một cặp đặc trưng và nhãn tương ứng với chỉ số idx

# Tạo dữ liệu
dataset = IrisTorch(X, y)

# Bước 4: Chia tập dữ liệu thành tập huấn luyện và tập kiểm tra bằng
cách chia ngẫu nhiên 70,30.
total_size = len(dataset)
train_size = int(0.7 * total_size)
#70%
test_size = total_size - train_size
#30%
train_dataset, test_dataset = random_split(dataset, [train_size,
test_size])

from importlib.abc import Loader
# Tạo DataLoader
batch_size = 64
train_loader = DataLoader(train_dataset, batch_size=batch_size,
shuffle=True)
test_loader = DataLoader(test_dataset, batch_size=batch_size,
shuffle=False)

# Bước 5: Định nghĩa criterion và optimizer
n_features = X.shape[1]
model = LogisticRegressTorch(n_features)
```

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criterion = nn.BCELoss()
optimizer = optim.SGD(model.parameters(), lr=0.01)

# Huấn luyện mô hình
n_epochs = 200
train_losses = []
test_losses = []
test_accuracies = []

for epoch in range(n_epochs):
    model.train()
    train_loss = 0.0
    for inputs, targets in train_loader:
        optimizer.zero_grad()
        outputs = model(inputs)
        loss = criterion(outputs, targets)
        loss.backward()
        optimizer.step()
        train_loss += loss.item() * inputs.size(0)

    train_loss /= len(train_loader.dataset)
    train_losses.append(train_loss)

    # Đánh giá trên tập kiểm tra
    model.eval()
    test_loss = 0.0
    correct = 0
    total = 0
    with torch.no_grad():
        for inputs, targets in test_loader:
            outputs = model(inputs)
            loss = criterion(outputs, targets)
            test_loss += loss.item() * inputs.size(0)

            predicted = (outputs >= 0.5).float()
            total += targets.size(0)
            correct += (predicted == targets).sum().item()

    test_loss /= len(test_loader.dataset)
    test_losses.append(test_loss)

    accuracy = correct / total
    test_accuracies.append(accuracy)

    print(f'Epoch {epoch+1}/{n_epochs}, Train Loss: {train_loss:.4f},
Test Loss: {test_loss:.4f}, Test Accuracy: {accuracy:.4f}')

Epoch 1/200, Train Loss: 0.8040, Test Loss: 0.8194, Test Accuracy:
0.4000
Epoch 2/200, Train Loss: 0.6436, Test Loss: 0.7441, Test Accuracy:

```

0.4000
Epoch 3/200, Train Loss: 0.5934, Test Loss: 0.6633, Test Accuracy:
0.4000
Epoch 4/200, Train Loss: 0.5432, Test Loss: 0.6077, Test Accuracy:
0.4333
Epoch 5/200, Train Loss: 0.5078, Test Loss: 0.5405, Test Accuracy:
0.6000
Epoch 6/200, Train Loss: 0.4705, Test Loss: 0.5121, Test Accuracy:
0.7333
Epoch 7/200, Train Loss: 0.4542, Test Loss: 0.4913, Test Accuracy:
0.8667
Epoch 8/200, Train Loss: 0.4422, Test Loss: 0.4738, Test Accuracy:
0.9667
Epoch 9/200, Train Loss: 0.4326, Test Loss: 0.4696, Test Accuracy:
0.9667
Epoch 10/200, Train Loss: 0.4279, Test Loss: 0.4538, Test Accuracy:
0.9667
Epoch 11/200, Train Loss: 0.4185, Test Loss: 0.4320, Test Accuracy:
1.0000
Epoch 12/200, Train Loss: 0.4086, Test Loss: 0.4346, Test Accuracy:
1.0000
Epoch 13/200, Train Loss: 0.4067, Test Loss: 0.4245, Test Accuracy:
1.0000
Epoch 14/200, Train Loss: 0.4001, Test Loss: 0.4024, Test Accuracy:
1.0000
Epoch 15/200, Train Loss: 0.3911, Test Loss: 0.4002, Test Accuracy:
1.0000
Epoch 16/200, Train Loss: 0.3880, Test Loss: 0.4029, Test Accuracy:
1.0000
Epoch 17/200, Train Loss: 0.3858, Test Loss: 0.3920, Test Accuracy:
1.0000
Epoch 18/200, Train Loss: 0.3805, Test Loss: 0.3965, Test Accuracy:
1.0000
Epoch 19/200, Train Loss: 0.3791, Test Loss: 0.3918, Test Accuracy:
1.0000
Epoch 20/200, Train Loss: 0.3750, Test Loss: 0.3808, Test Accuracy:
1.0000
Epoch 21/200, Train Loss: 0.3696, Test Loss: 0.3771, Test Accuracy:
1.0000
Epoch 22/200, Train Loss: 0.3661, Test Loss: 0.3677, Test Accuracy:
1.0000
Epoch 23/200, Train Loss: 0.3615, Test Loss: 0.3652, Test Accuracy:
1.0000
Epoch 24/200, Train Loss: 0.3583, Test Loss: 0.3578, Test Accuracy:
1.0000
Epoch 25/200, Train Loss: 0.3543, Test Loss: 0.3466, Test Accuracy:
1.0000
Epoch 26/200, Train Loss: 0.3504, Test Loss: 0.3463, Test Accuracy:
1.0000

Epoch 27/200, Train Loss: 0.3475, Test Loss: 0.3414, Test Accuracy: 1.0000
Epoch 28/200, Train Loss: 0.3443, Test Loss: 0.3330, Test Accuracy: 1.0000
Epoch 29/200, Train Loss: 0.3414, Test Loss: 0.3338, Test Accuracy: 1.0000
Epoch 30/200, Train Loss: 0.3384, Test Loss: 0.3341, Test Accuracy: 1.0000
Epoch 31/200, Train Loss: 0.3357, Test Loss: 0.3330, Test Accuracy: 1.0000
Epoch 32/200, Train Loss: 0.3334, Test Loss: 0.3433, Test Accuracy: 1.0000
Epoch 33/200, Train Loss: 0.3325, Test Loss: 0.3257, Test Accuracy: 1.0000
Epoch 34/200, Train Loss: 0.3273, Test Loss: 0.3208, Test Accuracy: 1.0000
Epoch 35/200, Train Loss: 0.3245, Test Loss: 0.3130, Test Accuracy: 1.0000
Epoch 36/200, Train Loss: 0.3220, Test Loss: 0.3101, Test Accuracy: 1.0000
Epoch 37/200, Train Loss: 0.3194, Test Loss: 0.3048, Test Accuracy: 1.0000
Epoch 38/200, Train Loss: 0.3173, Test Loss: 0.3063, Test Accuracy: 1.0000
Epoch 39/200, Train Loss: 0.3143, Test Loss: 0.2981, Test Accuracy: 1.0000
Epoch 40/200, Train Loss: 0.3128, Test Loss: 0.2988, Test Accuracy: 1.0000
Epoch 41/200, Train Loss: 0.3094, Test Loss: 0.2970, Test Accuracy: 1.0000
Epoch 42/200, Train Loss: 0.3069, Test Loss: 0.2948, Test Accuracy: 1.0000
Epoch 43/200, Train Loss: 0.3045, Test Loss: 0.2921, Test Accuracy: 1.0000
Epoch 44/200, Train Loss: 0.3022, Test Loss: 0.2906, Test Accuracy: 1.0000
Epoch 45/200, Train Loss: 0.2997, Test Loss: 0.2910, Test Accuracy: 1.0000
Epoch 46/200, Train Loss: 0.2973, Test Loss: 0.2848, Test Accuracy: 1.0000
Epoch 47/200, Train Loss: 0.2954, Test Loss: 0.2864, Test Accuracy: 1.0000
Epoch 48/200, Train Loss: 0.2927, Test Loss: 0.2874, Test Accuracy: 1.0000
Epoch 49/200, Train Loss: 0.2904, Test Loss: 0.2807, Test Accuracy: 1.0000
Epoch 50/200, Train Loss: 0.2883, Test Loss: 0.2785, Test Accuracy: 1.0000
Epoch 51/200, Train Loss: 0.2862, Test Loss: 0.2788, Test Accuracy:

1.0000
Epoch 52/200, Train Loss: 0.2839, Test Loss: 0.2825, Test Accuracy: 1.0000
Epoch 53/200, Train Loss: 0.2820, Test Loss: 0.2865, Test Accuracy: 1.0000
Epoch 54/200, Train Loss: 0.2807, Test Loss: 0.2779, Test Accuracy: 1.0000
Epoch 55/200, Train Loss: 0.2776, Test Loss: 0.2744, Test Accuracy: 1.0000
Epoch 56/200, Train Loss: 0.2756, Test Loss: 0.2707, Test Accuracy: 1.0000
Epoch 57/200, Train Loss: 0.2735, Test Loss: 0.2681, Test Accuracy: 1.0000
Epoch 58/200, Train Loss: 0.2716, Test Loss: 0.2630, Test Accuracy: 1.0000
Epoch 59/200, Train Loss: 0.2698, Test Loss: 0.2609, Test Accuracy: 1.0000
Epoch 60/200, Train Loss: 0.2679, Test Loss: 0.2589, Test Accuracy: 1.0000
Epoch 61/200, Train Loss: 0.2660, Test Loss: 0.2592, Test Accuracy: 1.0000
Epoch 62/200, Train Loss: 0.2640, Test Loss: 0.2571, Test Accuracy: 1.0000
Epoch 63/200, Train Loss: 0.2621, Test Loss: 0.2547, Test Accuracy: 1.0000
Epoch 64/200, Train Loss: 0.2604, Test Loss: 0.2529, Test Accuracy: 1.0000
Epoch 65/200, Train Loss: 0.2586, Test Loss: 0.2528, Test Accuracy: 1.0000
Epoch 66/200, Train Loss: 0.2567, Test Loss: 0.2478, Test Accuracy: 1.0000
Epoch 67/200, Train Loss: 0.2552, Test Loss: 0.2484, Test Accuracy: 1.0000
Epoch 68/200, Train Loss: 0.2533, Test Loss: 0.2430, Test Accuracy: 1.0000
Epoch 69/200, Train Loss: 0.2521, Test Loss: 0.2453, Test Accuracy: 1.0000
Epoch 70/200, Train Loss: 0.2498, Test Loss: 0.2431, Test Accuracy: 1.0000
Epoch 71/200, Train Loss: 0.2482, Test Loss: 0.2396, Test Accuracy: 1.0000
Epoch 72/200, Train Loss: 0.2468, Test Loss: 0.2402, Test Accuracy: 1.0000
Epoch 73/200, Train Loss: 0.2449, Test Loss: 0.2390, Test Accuracy: 1.0000
Epoch 74/200, Train Loss: 0.2433, Test Loss: 0.2420, Test Accuracy: 1.0000
Epoch 75/200, Train Loss: 0.2417, Test Loss: 0.2363, Test Accuracy: 1.0000

Epoch 76/200, Train Loss: 0.2401, Test Loss: 0.2346, Test Accuracy: 1.0000
Epoch 77/200, Train Loss: 0.2386, Test Loss: 0.2370, Test Accuracy: 1.0000
Epoch 78/200, Train Loss: 0.2371, Test Loss: 0.2397, Test Accuracy: 1.0000
Epoch 79/200, Train Loss: 0.2359, Test Loss: 0.2371, Test Accuracy: 1.0000
Epoch 80/200, Train Loss: 0.2343, Test Loss: 0.2321, Test Accuracy: 1.0000
Epoch 81/200, Train Loss: 0.2325, Test Loss: 0.2278, Test Accuracy: 1.0000
Epoch 82/200, Train Loss: 0.2310, Test Loss: 0.2254, Test Accuracy: 1.0000
Epoch 83/200, Train Loss: 0.2297, Test Loss: 0.2218, Test Accuracy: 1.0000
Epoch 84/200, Train Loss: 0.2287, Test Loss: 0.2191, Test Accuracy: 1.0000
Epoch 85/200, Train Loss: 0.2276, Test Loss: 0.2180, Test Accuracy: 1.0000
Epoch 86/200, Train Loss: 0.2262, Test Loss: 0.2171, Test Accuracy: 1.0000
Epoch 87/200, Train Loss: 0.2246, Test Loss: 0.2158, Test Accuracy: 1.0000
Epoch 88/200, Train Loss: 0.2234, Test Loss: 0.2134, Test Accuracy: 1.0000
Epoch 89/200, Train Loss: 0.2223, Test Loss: 0.2135, Test Accuracy: 1.0000
Epoch 90/200, Train Loss: 0.2206, Test Loss: 0.2124, Test Accuracy: 1.0000
Epoch 91/200, Train Loss: 0.2192, Test Loss: 0.2113, Test Accuracy: 1.0000
Epoch 92/200, Train Loss: 0.2178, Test Loss: 0.2136, Test Accuracy: 1.0000
Epoch 93/200, Train Loss: 0.2161, Test Loss: 0.2093, Test Accuracy: 1.0000
Epoch 94/200, Train Loss: 0.2152, Test Loss: 0.2086, Test Accuracy: 1.0000
Epoch 95/200, Train Loss: 0.2138, Test Loss: 0.2074, Test Accuracy: 1.0000
Epoch 96/200, Train Loss: 0.2126, Test Loss: 0.2072, Test Accuracy: 1.0000
Epoch 97/200, Train Loss: 0.2112, Test Loss: 0.2049, Test Accuracy: 1.0000
Epoch 98/200, Train Loss: 0.2102, Test Loss: 0.2028, Test Accuracy: 1.0000
Epoch 99/200, Train Loss: 0.2092, Test Loss: 0.2015, Test Accuracy: 1.0000
Epoch 100/200, Train Loss: 0.2080, Test Loss: 0.2012, Test Accuracy:

1.0000
Epoch 101/200, Train Loss: 0.2068, Test Loss: 0.1986, Test Accuracy: 1.0000
Epoch 102/200, Train Loss: 0.2061, Test Loss: 0.1957, Test Accuracy: 1.0000
Epoch 103/200, Train Loss: 0.2057, Test Loss: 0.1933, Test Accuracy: 1.0000
Epoch 104/200, Train Loss: 0.2055, Test Loss: 0.1922, Test Accuracy: 1.0000
Epoch 105/200, Train Loss: 0.2044, Test Loss: 0.1910, Test Accuracy: 1.0000
Epoch 106/200, Train Loss: 0.2033, Test Loss: 0.1917, Test Accuracy: 1.0000
Epoch 107/200, Train Loss: 0.2011, Test Loss: 0.1912, Test Accuracy: 1.0000
Epoch 108/200, Train Loss: 0.1997, Test Loss: 0.1899, Test Accuracy: 1.0000
Epoch 109/200, Train Loss: 0.1989, Test Loss: 0.1881, Test Accuracy: 1.0000
Epoch 110/200, Train Loss: 0.1981, Test Loss: 0.1878, Test Accuracy: 1.0000
Epoch 111/200, Train Loss: 0.1967, Test Loss: 0.1872, Test Accuracy: 1.0000
Epoch 112/200, Train Loss: 0.1954, Test Loss: 0.1866, Test Accuracy: 1.0000
Epoch 113/200, Train Loss: 0.1941, Test Loss: 0.1874, Test Accuracy: 1.0000
Epoch 114/200, Train Loss: 0.1926, Test Loss: 0.1880, Test Accuracy: 1.0000
Epoch 115/200, Train Loss: 0.1912, Test Loss: 0.1875, Test Accuracy: 1.0000
Epoch 116/200, Train Loss: 0.1902, Test Loss: 0.1901, Test Accuracy: 1.0000
Epoch 117/200, Train Loss: 0.1891, Test Loss: 0.1886, Test Accuracy: 1.0000
Epoch 118/200, Train Loss: 0.1881, Test Loss: 0.1863, Test Accuracy: 1.0000
Epoch 119/200, Train Loss: 0.1872, Test Loss: 0.1868, Test Accuracy: 1.0000
Epoch 120/200, Train Loss: 0.1862, Test Loss: 0.1867, Test Accuracy: 1.0000
Epoch 121/200, Train Loss: 0.1852, Test Loss: 0.1842, Test Accuracy: 1.0000
Epoch 122/200, Train Loss: 0.1842, Test Loss: 0.1825, Test Accuracy: 1.0000
Epoch 123/200, Train Loss: 0.1833, Test Loss: 0.1823, Test Accuracy: 1.0000
Epoch 124/200, Train Loss: 0.1824, Test Loss: 0.1839, Test Accuracy: 1.0000

Epoch 125/200, Train Loss: 0.1816, Test Loss: 0.1856, Test Accuracy: 1.0000
Epoch 126/200, Train Loss: 0.1810, Test Loss: 0.1850, Test Accuracy: 1.0000
Epoch 127/200, Train Loss: 0.1801, Test Loss: 0.1833, Test Accuracy: 1.0000
Epoch 128/200, Train Loss: 0.1791, Test Loss: 0.1784, Test Accuracy: 1.0000
Epoch 129/200, Train Loss: 0.1778, Test Loss: 0.1767, Test Accuracy: 1.0000
Epoch 130/200, Train Loss: 0.1769, Test Loss: 0.1762, Test Accuracy: 1.0000
Epoch 131/200, Train Loss: 0.1761, Test Loss: 0.1741, Test Accuracy: 1.0000
Epoch 132/200, Train Loss: 0.1753, Test Loss: 0.1737, Test Accuracy: 1.0000
Epoch 133/200, Train Loss: 0.1744, Test Loss: 0.1738, Test Accuracy: 1.0000
Epoch 134/200, Train Loss: 0.1735, Test Loss: 0.1727, Test Accuracy: 1.0000
Epoch 135/200, Train Loss: 0.1727, Test Loss: 0.1730, Test Accuracy: 1.0000
Epoch 136/200, Train Loss: 0.1719, Test Loss: 0.1712, Test Accuracy: 1.0000
Epoch 137/200, Train Loss: 0.1711, Test Loss: 0.1707, Test Accuracy: 1.0000
Epoch 138/200, Train Loss: 0.1702, Test Loss: 0.1696, Test Accuracy: 1.0000
Epoch 139/200, Train Loss: 0.1694, Test Loss: 0.1677, Test Accuracy: 1.0000
Epoch 140/200, Train Loss: 0.1687, Test Loss: 0.1680, Test Accuracy: 1.0000
Epoch 141/200, Train Loss: 0.1679, Test Loss: 0.1668, Test Accuracy: 1.0000
Epoch 142/200, Train Loss: 0.1671, Test Loss: 0.1687, Test Accuracy: 1.0000
Epoch 143/200, Train Loss: 0.1663, Test Loss: 0.1657, Test Accuracy: 1.0000
Epoch 144/200, Train Loss: 0.1655, Test Loss: 0.1659, Test Accuracy: 1.0000
Epoch 145/200, Train Loss: 0.1648, Test Loss: 0.1663, Test Accuracy: 1.0000
Epoch 146/200, Train Loss: 0.1641, Test Loss: 0.1666, Test Accuracy: 1.0000
Epoch 147/200, Train Loss: 0.1634, Test Loss: 0.1647, Test Accuracy: 1.0000
Epoch 148/200, Train Loss: 0.1625, Test Loss: 0.1621, Test Accuracy: 1.0000
Epoch 149/200, Train Loss: 0.1617, Test Loss: 0.1613, Test Accuracy: 1.0000

1.0000
Epoch 150/200, Train Loss: 0.1610, Test Loss: 0.1607, Test Accuracy: 1.0000
Epoch 151/200, Train Loss: 0.1603, Test Loss: 0.1591, Test Accuracy: 1.0000
Epoch 152/200, Train Loss: 0.1596, Test Loss: 0.1579, Test Accuracy: 1.0000
Epoch 153/200, Train Loss: 0.1589, Test Loss: 0.1583, Test Accuracy: 1.0000
Epoch 154/200, Train Loss: 0.1582, Test Loss: 0.1606, Test Accuracy: 1.0000
Epoch 155/200, Train Loss: 0.1576, Test Loss: 0.1594, Test Accuracy: 1.0000
Epoch 156/200, Train Loss: 0.1568, Test Loss: 0.1576, Test Accuracy: 1.0000
Epoch 157/200, Train Loss: 0.1561, Test Loss: 0.1565, Test Accuracy: 1.0000
Epoch 158/200, Train Loss: 0.1554, Test Loss: 0.1565, Test Accuracy: 1.0000
Epoch 159/200, Train Loss: 0.1547, Test Loss: 0.1566, Test Accuracy: 1.0000
Epoch 160/200, Train Loss: 0.1541, Test Loss: 0.1554, Test Accuracy: 1.0000
Epoch 161/200, Train Loss: 0.1534, Test Loss: 0.1549, Test Accuracy: 1.0000
Epoch 162/200, Train Loss: 0.1527, Test Loss: 0.1529, Test Accuracy: 1.0000
Epoch 163/200, Train Loss: 0.1520, Test Loss: 0.1531, Test Accuracy: 1.0000
Epoch 164/200, Train Loss: 0.1514, Test Loss: 0.1542, Test Accuracy: 1.0000
Epoch 165/200, Train Loss: 0.1509, Test Loss: 0.1529, Test Accuracy: 1.0000
Epoch 166/200, Train Loss: 0.1502, Test Loss: 0.1527, Test Accuracy: 1.0000
Epoch 167/200, Train Loss: 0.1496, Test Loss: 0.1523, Test Accuracy: 1.0000
Epoch 168/200, Train Loss: 0.1490, Test Loss: 0.1497, Test Accuracy: 1.0000
Epoch 169/200, Train Loss: 0.1482, Test Loss: 0.1509, Test Accuracy: 1.0000
Epoch 170/200, Train Loss: 0.1477, Test Loss: 0.1488, Test Accuracy: 1.0000
Epoch 171/200, Train Loss: 0.1470, Test Loss: 0.1479, Test Accuracy: 1.0000
Epoch 172/200, Train Loss: 0.1464, Test Loss: 0.1473, Test Accuracy: 1.0000
Epoch 173/200, Train Loss: 0.1458, Test Loss: 0.1452, Test Accuracy: 1.0000

Epoch 174/200, Train Loss: 0.1452, Test Loss: 0.1442, Test Accuracy: 1.0000
Epoch 175/200, Train Loss: 0.1446, Test Loss: 0.1433, Test Accuracy: 1.0000
Epoch 176/200, Train Loss: 0.1440, Test Loss: 0.1424, Test Accuracy: 1.0000
Epoch 177/200, Train Loss: 0.1435, Test Loss: 0.1435, Test Accuracy: 1.0000
Epoch 178/200, Train Loss: 0.1428, Test Loss: 0.1429, Test Accuracy: 1.0000
Epoch 179/200, Train Loss: 0.1423, Test Loss: 0.1429, Test Accuracy: 1.0000
Epoch 180/200, Train Loss: 0.1417, Test Loss: 0.1412, Test Accuracy: 1.0000
Epoch 181/200, Train Loss: 0.1411, Test Loss: 0.1411, Test Accuracy: 1.0000
Epoch 182/200, Train Loss: 0.1406, Test Loss: 0.1395, Test Accuracy: 1.0000
Epoch 183/200, Train Loss: 0.1401, Test Loss: 0.1383, Test Accuracy: 1.0000
Epoch 184/200, Train Loss: 0.1396, Test Loss: 0.1387, Test Accuracy: 1.0000
Epoch 185/200, Train Loss: 0.1390, Test Loss: 0.1388, Test Accuracy: 1.0000
Epoch 186/200, Train Loss: 0.1384, Test Loss: 0.1380, Test Accuracy: 1.0000
Epoch 187/200, Train Loss: 0.1379, Test Loss: 0.1382, Test Accuracy: 1.0000
Epoch 188/200, Train Loss: 0.1373, Test Loss: 0.1375, Test Accuracy: 1.0000
Epoch 189/200, Train Loss: 0.1368, Test Loss: 0.1361, Test Accuracy: 1.0000
Epoch 190/200, Train Loss: 0.1363, Test Loss: 0.1356, Test Accuracy: 1.0000
Epoch 191/200, Train Loss: 0.1358, Test Loss: 0.1345, Test Accuracy: 1.0000
Epoch 192/200, Train Loss: 0.1353, Test Loss: 0.1334, Test Accuracy: 1.0000
Epoch 193/200, Train Loss: 0.1349, Test Loss: 0.1339, Test Accuracy: 1.0000
Epoch 194/200, Train Loss: 0.1342, Test Loss: 0.1339, Test Accuracy: 1.0000
Epoch 195/200, Train Loss: 0.1337, Test Loss: 0.1333, Test Accuracy: 1.0000
Epoch 196/200, Train Loss: 0.1332, Test Loss: 0.1335, Test Accuracy: 1.0000
Epoch 197/200, Train Loss: 0.1327, Test Loss: 0.1312, Test Accuracy: 1.0000
Epoch 198/200, Train Loss: 0.1323, Test Loss: 0.1299, Test Accuracy: 1.0000

Epoch 199/200, Train Loss: 0.1320, Test Loss: 0.1301, Test Accuracy: 1.0000
Epoch 200/200, Train Loss: 0.1313, Test Loss: 0.1294, Test Accuracy: 1.0000

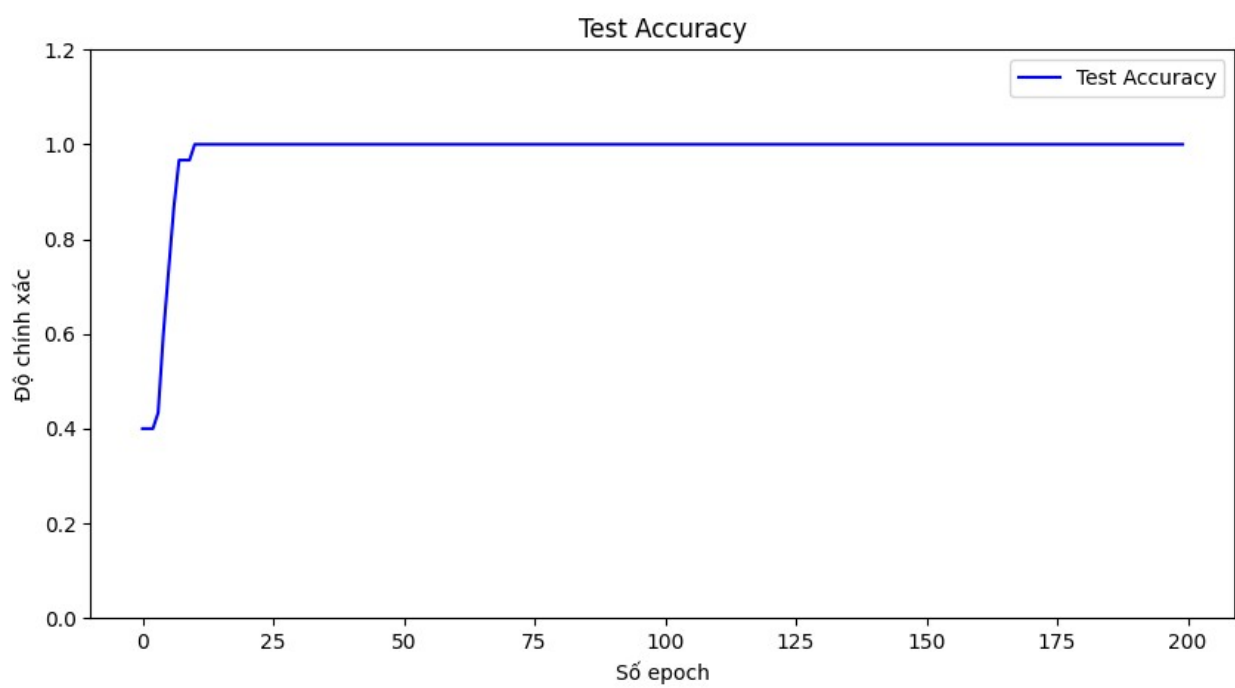
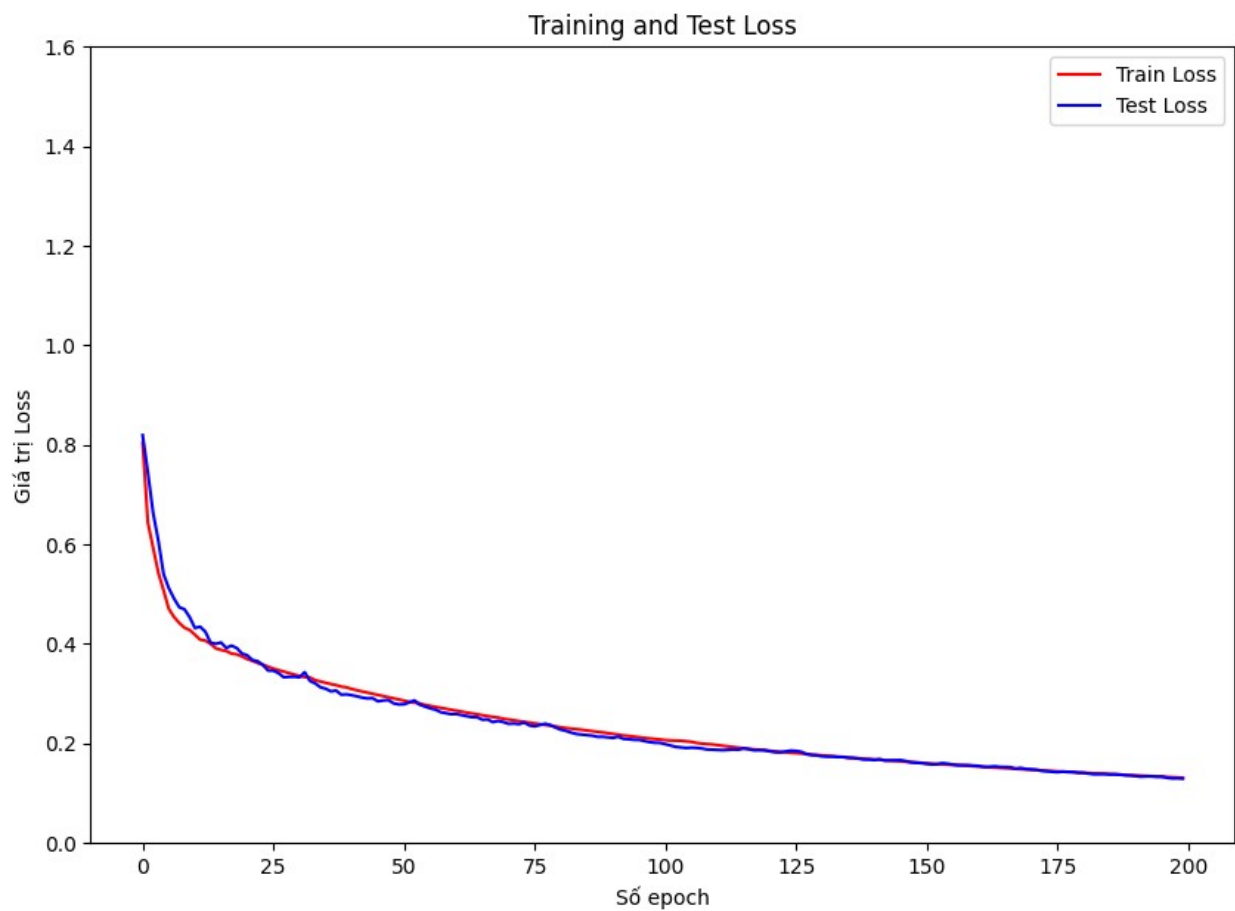
Vẽ biê' u đồ' loss và accuracy

Vẽ biê' u đồ' loss

```
plt.figure(figsize=(10, 7))
plt.plot(train_losses, label='Train Loss', color='red')
plt.plot(test_losses, label='Test Loss', color='blue')
plt.xlabel('Số epoch')
plt.ylabel('Giá trị Loss')
plt.title('Training and Test Loss')
plt.legend()
plt.ylim(0, 1.6) # Đặt giá trị tối đa cho trục Y là 1.6
plt.show()
```

Vẽ biê' u đồ' accuracy

```
plt.figure(figsize=(10, 5))
plt.plot(test accuracies, label='Test Accuracy', color='blue')
plt.xlabel('Số epoch')
plt.ylabel('Độ chính xác')
plt.title('Test Accuracy')
plt.legend()
plt.ylim(0, 1.2) # Đặt giá trị tối đa cho trục Y là 1.0
plt.show()
```



#Kết quả:

image.png